Appendix C

Methodology for Calculating Cost-Effectiveness of Fugitive Dust Control Measures

INTRODUCTION

In compiling information on control cost-effectiveness estimates for the fugitive dust handbook, we discovered that many of the estimates provided in contractor reports prepared for air quality agencies for PM10 SIPs contain either hard to substantiate assumptions or unrealistic assumptions. Depending on which assumptions are used, the control cost-effectiveness estimates can range over one to two orders of magnitude. Rather than presenting existing cost-effectiveness estimates, we have prepared a detailed methodology containing the steps to calculate cost-effectiveness which is presented below. We recommend that the handbook user calculate the cost-effectiveness values for different fugitive dust control options based on current cost data and assumptions that are applicable to their particular situation.

Based on field measurements of uncontrolled and controlled unpaved road emissions conducted by Midwest Research Institute, there were no significant differences in the measured control efficiencies for the PM2.5 and PM10 size fractions. Thus, the cost-effectiveness for PM2.5 reduction can be calculated by dividing the cost-effectiveness estimate for PM10 reduction by the PM2.5/PM10 ratio for that fugitive dust source. The ratios published in AP-42 range from 0.15 to 0.25; however, there is some evidence that these ratios may be high by a factor of two. Controlled laboratory tests to be scheduled as part of the DEJF research plan for FY 2005 will address the PM2.5/PM10 ratio for several resuspended soils.

TECHNICAL APPROACH

The steps necessary to calculate the cost-effectiveness for different fugitive dust control measures are listed below. This methodology was employed to calculate the cost-effectiveness for each control application case study for the eight different fugitive dust source categories addressed in the handbook.

Step 1: Select a specific control measure for the fugitive dust source category of interest.

Step 2: Specify the basic parameters required to calculate uncontrolled and controlled emissions for the specific source:

- applicable emission factor equation
- parameters used in the emission factor equation
- source extent (activity level)
- characteristics of the source
- control measure implementation schedule (frequency, application rate)

Step 3: Calculate the annual uncontrolled emission rate as the product of the emission factor and the source extent (from Step 2).

Step 4: Determine the control efficiency for the selected control measure. This may involve either (a) using a published value, (b) calculating the control efficiency based on comparing the controlled emissions estimate derived from the applicable

emission factor equation with the uncontrolled emissions estimate derived from the same emission factor equation, or (c) specifying the desired control efficiency which then will entail determining the appropriate level of control to achieve the desired control efficiency.

Step 5: Calculate the annual controlled emissions rate (if not already calculated in step 4) as the product of the annual uncontrolled emission rate (from Step 3) multiplied by the quantity 1 minus the control efficiency (from Step 4), where the fractional control efficiency is expressed as a fractional control efficiency.

Step 6: Calculate the reduction in emissions as the difference between the annual uncontrolled emission rate (from Step 3) and the annual controlled emission rate (from Step 5).

Step 7: Gather cost estimates for implementing the selected control measure for the following items:

- annualized capital costs (total capital costs/lifetime of the control)
- annual operating and maintenance costs
- annual overhead costs (in the sample cost-effectiveness calculations included in the handbook, we assumed that the annual overhead cost was one-half the annual operating and maintenance costs)
- annual enforcement/compliance costs

Step 8: Calculate the annualized capital investment cost as the product of the annual capital cost and the capital recovery factor. The capital recovery factor is calculated as follows:

$$CRF = [\, i\,(1 + i\,)^{n}\,] \,/\, [(1 + i)^{n} - 1]$$

where, CRF = capital recovery factor
i = annual interest rate (fraction)
n = number of payment years

Step 9: Calculate the total annualized cost by combining the annualized capital investment cost (from Step 8) with annual operating and maintenance costs, annual overhead costs, and annual enforcement/compliance costs (from Step 7).

Step 10: Calculate the cost-effectiveness of the selected control measure by dividing the total annualized costs (from Step 9) by the emissions reduction. The emissions reduction is determined by subtracting the controlled emissions (from Step 5) from the uncontrolled emissions (from Step 3).